Localized Raman in-situ spectroelectrochemistry: anti-Stokes scattering of graphene at high doping regime

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We present a localized microdroplet (spectro)electrochemistry setup for investigation of 2D materials, integrating in situ Raman spectroscopy with high resolution of the electrochemical measurements an micrometer-sized aquaes electrolyte droplets. This technique enables efficient electrolyte gatingand voltammetry measurements, all complemented by in situ Raman spectroscopy. These capabilities provide valuable insights into the properties of 2D materials.
Localized experiments on monolayer graphene reveal differences in charge-transfer processes taking place at the basal plane and in defect-rich areas [1], enable the observation of Fermi level decay outside the electrochemically gated region, and show that gating efficiency is independent of the ionic electrolyte type in the high electrolyte concentration regime [2].
We will discuss the distinct behavior of the graphene G band in the Stokes and anti-Stokes regions at high electrochemical doping levels—a region not previously accessed under such conditions. The data provides a new perspective on charge-transfer dynamics during electrochemical doping, offering fresh insights into the interplay between graphene's electronic structure and vibrational behavior, with applicability to other two-dimensional materials.

References

[1] Martin Jindra, Matěj Velický, Milan Bouša, Ghulam Abbas, Martin Kalbáč, and Otakar Frank, The Journal of Physical Chemistry Letters, 13/2 (2022) , 642-648

[2] Ghulam Abbas, Farjana J. Sonia, Martin Jindra, Jiří Červenka, Martin Kalbáč, Otakar Frank, and Matěj Velický, The Journal of Physical Chemistry Letters, *14/18 (2023)*, 4281-4288

Figures

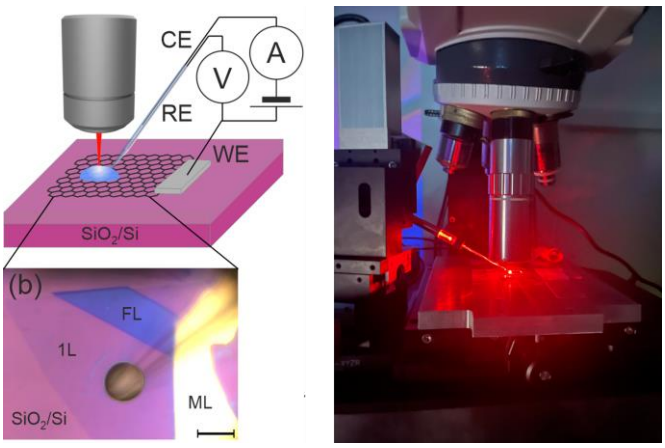

Figure 1: Scheme (with the microscope image) and the real setup of the localized microdroplet spectroelectrochemistry